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RESPONSE OF VALENCIA ORANGE TREES TO DIFFERENT SOURCES OF BIO-FERTILIZERS

BY

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ABSTRACT

The present study was carried out during the two successive seasons of 2005 and 2006 at a private orchard at 79km north El-Tahreer, El-Behera Governorate Egypt to study the effect of two different sources of fertilizers, i.e. mineral and biological either single or combined application on Valencia orange trees (*C. sinensis* L. Osbeck) of ten years old, budded on sour orange (*C. aurantium*, L.) rootstock. Biofertilizers were used as N_2- fixing (Netrobein, Biogein, Rhizobacterein and Mecrobein) at the rates of 1/2 and 1/4 kg/tree, while phosphorein as a source of phosphorus dissolving bacteria which added as 200 and 100 gm/tree, potassein was sprayed at the rates of 1/4 L and 1/8 L./20 L water and Coatangein was added as 80 and 40 gm/tree. The chemical fertilizer treatments were added at the rates of (800, 400, 400) and (400, 200, 200) gm/tree for N, P and K respectively, either single or combined treatments respectively. The trees were sprayed with Fe, Zn and Mn as sulphate at 0.4%. The amount of Nitrogen (chemical and bio) fertilizers were divided into three doses in January, March and August, while suerphosphate and phosphorein were added in one dose in January. Potassium and Potassein were divided into two doses and added in March and August. Fe, Zn and Mn and Coatangein were divided into three doses sprayed three times at the middle of Febrauary, just after fruit setting and at one month later. The obtained results indicated that all combined treatments were the most favorable in increasing shoot length, leaves number per shoot, leaf area, leaf chlorophyll (a & b), leaf macro and micronutrients (N, P, K, Fe, Zn and Mn), fruit set%, fruiting %, yield as well as fruit weight, fruit size, juice percentage, T.S.S.%, T.S.S./ acid ratio, vitamin C, soil N, P and K and soil microbiological content and Economic benefit per feddan. Meanwhile, they reduced leaf carotene, fruit June drop%, total acidity and soil PH. On the other hand, the single biofertilizer treatments were favorable for increasing soil CO_2 evaluation, dehydrogenase activity, organic carbon and total count of bacteria than the combined ones while the chemical treatment were recorded the lowest. Combined application of mineral fertilizer and biofertilizers especially using Rhizobacterein was more preferable than minerals or bio fertilizers as single treatments.

INTRODUCTION

Nitrogen is required for trees growth. It is necessary for building up protein, enzymes and vitamins as well as in chlorophyll in tree. The excessive application of chemical fertilizers led to increase cost and diminishing soil fertility. The residual of chemical fertilizers has seriously affected on the quality of agricultural products and people's health, caused environmental pollution. Therefore, a great interest has been generated to apply bioorganic and inorganic additions to establish a good eco-environment. Biofertilizers were living microorganisms involved in symbiotic and associative microbial activities with higher plants. They are used for increasing agricultural productivity beside improving soil fertility. (Larson *et al.*, 1962, Ferguson *et al.*, 1987 and Idso *et al.*, 1995). Using biofertilizer as single application or in the presence of different levels of NPK induced a significant increase in trees growth, Reese and Koo (1977) on Temple orange, Pomares, *et al.* (1983), on citrus trees, Motskobili, (1984) on Satsuma mandarin, Rabeh, *et al.* (1993) on Balady mandarin, Huang, *et al.* (1995) on Satsuma mandarin, and Hegab & Ahmed (1997) on Navel orange trees. All they indicated that biofertilizers combined with mineral Nitrogen fertilizer increased trees height, shoot length, number of branches/ tree, number of leaves per shoot, leaf area, leaf chlorophyll and minerals content, total yield/fed. and fruit quality of trees. Furthermore, Grassi, *et al.* (1999), on Rangpour lime obtained a significant increment in yield and fruit quality due to adding biofertilizers. Reese and Koo (1977), on orange trees, Hegab and Ahmed (1997), on Valencia orange trees and Abou Sayed, (1997), on balady mandarin reported the highest number of fruits per tree as well as the highest fruit yield, fruit weight, juice T.S.S., T.S.S./ acid ratio and Ascorbic acid, while reduced June drop and juice acidity(%) when trees inoculated with biofertilizer and fertilized by 50% of recommended N rate. Applying bio-fertilizer to soil for reducing soil pH as well as increasing N, P and K soil contents were obtained Reese and Koo (1977), on orange trees, Pomares, *et al.* (1983) On citrus trees, Ibrahim and Abd El- Aziz (1993) On Balady mandarin, and El-Kobbiaobbia, (1999), on Navel orange trees. Regarding the effect of applying chemical fertilizers plus bio-fertilizers on a soil chemical composition, they observed that 50% of the recommended N rate and treating with Azosprillum caused a highest soil NPK contents and reduced soil pH by secreting organic acids such as acetic, propionic and fumaric which lowered soil pH. Moreover, biofertilizers have become appropriate tool for reducing environmental pollution, increasing productivity, either yield or fruit quality and protect human and animal health. The various positive effects and benefits of applying biofertilizers were attributed to its own different nutrients and the natural plant hormone namely, cytokinins. Inoculation with Azotobacter had an effect on total bacterial counts, Azotobacter spp (Ishac *et al.*, 1982). Inoculation of plants with Azospirillum increased total number of bacteria, CO_2 evaluation, dehydrogenase activity and organic carbon in soil (El-Haddad *et al.*, 1986). The influence of different biofertilizers types either as N_2-fixing or P-dissolving bacteria on soil microbiological properties in sandy soils were as follows: Nitrobein> Biogein> Microbein> Rhizobacterein and the microbial population was $5.5x\ 10^7$ N_2 fixer bacteria/ gm dry soil Dhruva Kumar *et al.* (1992) and (El-Ghany, 1996). The purpose of reducing production cost and increase net return Ghoneim *et al.* (1999); Abd El – Fattah (2000), Gaber *et al.* (2001) and El-Khatib *et al.* (2003).. The substitution of, at least, part of the mineral N-fertilizers by some N-fixing bacteria fertilizers is, economically greatly desired. In addition, the supplement of such plants, especially those grown under sandy soil conditions. Therefore, the aim of the present work was to study the effect of applying of various commercial bacterial fertilizer individually or combined with minerals fertilizers on vegetative growth, leaf pigments and minerals content, fruiting, yield, fruit physical and chemical characters of Valencia orange trees. Also, soil mineral and microbiological contents to reduce amount of artificial N fertilizer for reducing the environmental pollution and production cost.

MATERIALS AND METHODS

The present study was carried out during the two successive seasons of 2005 and 2006 at a private orchard in Ragab farm at 79km north El-Tahreer, El-Behera Governorate Egypt to study the effect of two different sources of fertilizers, i.e. mineral and biological either as single or in combination on Valencia orange trees (*C. sinensis* L .Osbeck) of ten years old, budded on sour orange (*C. aurantium*, L.) rootstock. Trees were planted at 5x5 meter apart, nearly similar in growth. The treatments of the experiment were arranged as factorial experiment in a complete randomized block design on this concern each treatment was replicated three times with three trees per each replicate. Thus, the experiment included nine treatments as follow:-

1- Nitrobein (1/2 kg) +phosphorein (200 gm)+ potasein (1/4 L)+ coatangein (80 gm)(bio1)
2- Biogein(1/2 kg) +phosphorein (200 gm)+ potasein (1/4 L)+ coatangein (80 gm) (bio 2)
3- Rhizobacterien(1/2 kg)+phosphorein (200 gm)+potasein (1/4 L)+coatangein (80 gm)(bio 3)
4- Microbein(1/2 kg)+phosphorein (200 gm)+potasein (1/4 L.)+coatangein (80 gm) (bio 4)
5- 50% of chemical fertilizer+ 50% of treatment (1)
6- 50% of chemical fertilizer + 50% of treatment (2)
7- 50% of chemical fertilizer + 50% of treatment (3)
8- 50% of chemical fertilizer + 50% of treatment (4)
9- Control 100% chemical fertilizer (800, 400, 400) gm/tree.

The amount of mineral fertilizers and time of application are shown in Table (1).

Table (1): Mineral fertilizer type, rate, dose, amount and time of applications in the experiment.

Fertilizer type	Fertilizer rate(%)	No. of dose	Amount of fertilizer (gm/ tree)	Time of application
Ammonium sulphate (20.5%N)	100 50	3 3	800 400	January, March, August
Calcium super phosphate (15.5%p_2o_5)	100 50	1 1	400 200	January
Potassium sulphate (48% k_2O)	100 50	2 2	400 200	March, August

0.4% Zinc, iron and manganese in the form of sulphate salt were sprayed. The trees were sprayed three times at the middle of February, Just after fruit set and at one month later. At the starting of the experiment soil mechanical and chemical analysis were performed according to Piper (1950) and Jackson (1958), respectively as cleared in Table (2).

Table (2): Mechanical and chemical analysis of the soil.

Mechanical analysis %		Chemical analysis									
Sand	94.0	E.C. Ms/ cm	pH	Soluble cations				Soluble anions			
Silt	2.5			Ca	Mg	Na	K	Hco_3	Co_3	Cl	So_4
Clay	3.5			mg/ 100g soil				meq/1			
Texture class	Sandy			5.8	4.6	2.7	1.7	2.4	5.7	6.7	nill
O.M.	0.4	1.7	8.34								

The source of bio-fertilizers:

1- **Nitrobein**: a mixture of N_2 fixing (Azotobacter sp and Azospirillum sp) under the commercial name of "Nitrobein".
2- **Biogein:** Contains live cells of efficient bacteria which capable of N_2 fixation under the commercial name of "Biogein".
3- **Microbein:** a mixture of N_2 fixing (Azotobacter sp and Azospirillum sp), P seudomonas bacteria (Bacillus sp) under the commercial name of "Microbein".
4- **Rhizobacterein:** Containing N_2 fixing bacteria (Rhizobacterium Leguminosarum) under the commercial name of "Rhizobacterein".
5- **Phosphorein**: a mixture of Bacillus megaterium phosphate dissolving bacteria. The active bacteria is capable in transform the tricalcium phosphate to mono- calcium phosphate (Ashour and Sarhan 1998).
6- **Potassein** F: 30% k_2o + 10% P_2O_5
7- **Coatengein**: A chelating micronutrients fertilizer by weight contains Fe, Mn and Zn at the ratio of 2:1:2.

All the biofertilizers which used are produced and distributed commercially by General Organization Equalization Fund (GOEF), ministry of Agriculture, Egypt.

The amount of N_2 fixation bacteria was 1/2kg per tree as single treatments and was 1/4kg/tree in the combination and was divided into three doses in January, March and August, while phosphorein was added 200gm/tree as single treatment and was 100gm/tree in the combination in one dose in January. Each dose of biofertilizers was mixed with moist sand and added in soil hole around the trunk of the tree and directly irrigated after covering the hole. Potassein sprayed as a solution (1/4L. potassein/20 L. water) and (1/8L. potassein/ 20L. water) per tree as single or in combination treatments, respectively divided into two doses, before flowering and after fruit set. Coatengein at the rates of 80and 40gm per tree either as single or in combination treatments respectively divided into three doses while trees were sprayed with Coatengein three times at the middle of February, Just after fruit set and one month later.

The chosen trees had received the same management practices that recommended by the Egyptian Ministry of Agriculture. Another agricultural practice such as irrigation, hoeing, pruning and pest control were usually done.

Studied characters:

A- Vegetative growth:

In early March of the two seasons, four branches (about 2.5 cm) in diameter were labeled on each treated tree at the four directions for studying shoot length (cm) and leaves number per shoot. Leaf area (cm^2): was measured according to Chou (1966) [2/ 3 length x width of leaf].

B- Leaf chemical analysis:

B-1- Leaf pigments content: In September of each season, 20 mature leaves of 6 months old of spring growth cycle were rand only sampled where chlorophyll a, b and carotene contents were estimated according to Comar and Zcheile (1941)

B-2- Leaf minerals content: In September of each season, 30 mature leaves of 6 months old of spring growth cycle were rand only sampled. These leaves were cleaned with tap water then rinsed in a distilled water to remove any residues. The leaves were dried in electric oven at 70^0C till constant weight then ground. 0.2 gm of each ground sample was digested as solution for the determination of N, P, K, Fe, Zn and Mn nutrients as follow:

Total Nitrogen: was determined according to Microkjedahl method as described by Pregl (1945), While Phosphorus was determined by using the method of Chapman and Pratt (1961). Potassium was determined by photometric method as described by Brown and Lilliland (1946).

Zn, Fe, and Mn: were estimated by using an atomic absorption spectrophotometer as described by Brand Ifield and Spincer (1965).

C- Fruiting parameters:

C-1- Fruit set percentage:

Fruit set%: Using the following equation:

$$\text{Fruit set \%} = \frac{\text{Number of setted fruits}}{\text{Total number of flowers}} \times 100$$

C-2- June drop %:-

At early May and at the end of June, the number of remained fruits on each labeled branch were counted then June drop percentage was calculated according to the equation given by Vyvyan (1946).

$$\text{June drop \%} = \frac{\text{Log } x1 - \text{Log } x2}{T1 - T2} \times 100$$

Where x1 &x2 = number of fruits per tagged branches at T1 &T2 times (early May and end June).

C-3-Fruiting (%):

Number of remained fruits on each tagged branch of each tree counted then fruiting percentage was calculated as follow:

$$\text{Fruiting \%} = \frac{\text{No. of fruits at harvesting time on the tagged branches}}{\text{No. of flowers on the tagged branches}} \times 100$$

D- Yield:

At harvesting time (mid. April) of each season total number of fruits per tree for each treatment and fruit weight (gm) were recorded. Estimated yield per tree (kg) was also concerned then yield was calculated per feddan (Tons).

E Fruit quality:

After fruits reached maturity according to Nasr (1982) (250 days from full bloom), ten fruits were randomly sampled from each tree to determine fruit characteristics as follow: Fruit weight (gm), fruit size(cm^3), juice percentage(%), Total soluble solids (T.S.S.%) using hand refractometer Abbe, Total acidity % as citric acid, Ascorbic acid mg/100ml juice in fruit juice were determined according to A.O.A.C.(1985). In addition, T.S.S./ acid ratio was calculated.

F- Soil analysis: At the end of the experiment

F-1- Soil chemical analysis was performed according to Wilde *et al.* (1985) method for measuring pH and soil N, P and K contents.

F-2- Soil microbiological analysis: Soil sample were analyzed microbiologically using the stand ard procedures described by Black *et al.* (1965) and Page *et al.* (1982). 10 gm of each soil sample was diluted in sterile water and mixed for 10 min in a magnetic stirrer operating at half speed. The soil suspension was diluted in 10-fold series in 250ml bottles, and five Petri dishes containing solid media were inoculated from each dilution. The serial dilution plate method was used for measuring CO_2 evaluation, dehydrogenase activity, organic carbon and counting total bacteria on soil and conducted in Soils, Water and Environment Res. Instit., Agric. Res. Centre, Giza, Egypt.

G: **Economic benefit study:** By calculating the net return values obtained by different treatments.

H- **Statistical analysis:** The obtained data of each season were statistically analyzed using the procedure outlined by Snedecor and Cochran (1980). Also, data were tested for least significant differences to compare the averages of the considered parameters.

RESULTS AND DISCUSSION

Vegetative growth:

Data of Table (3) concerning the effect of chemical fertilizer and biofertilizers either as single or in combination treatments on vegetative growth of trees, it is apparent that the rate of 50% from both (chem. +bio.) fertilizers produced the highest values of shoot length, leaves number per shoot and leaf area, while the lowest values obtained by inoculation with biofertilizer only as single. 100% chemical fertilizers recorded the middle values. In addition, 50% Rhizobacterein in combined with 50% of chemical fertilizer exhibited the highest mean values for all mentioned growth parameters followed by Microbein, Nitrobein, whereas Biogein gave the lowest values.

Table (3): Shoot length, leaves number per shoot and leaf area of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Growth characters		Shoot length (cm)			Leaves number/ shoot			Leaf area (cm2)		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	11.30	11.40	11.35	4.40	4.80	4.60	17.80	17.70	17.75
	Bio (2)	11.10	11.20	11.15	4.30	4.70	4.50	17.60	17.50	17.55
	Bio (3)	11.60	11.80	11.70	4.70	5.10	4.90	18.20	18.00	18.10
	Bio (4)	11.40	11.60	11.50	4.50	4.90	4.70	18.00	17.90	17.95
	Mean	11.35	11.50	11.43	4.75	4.88	4.81	17.90	17.87	17.84
Bio + chemical fertilizer	50% NPK+50%Bio(1)	12.90	13.10	13.00	5.90	6.30	6.10	18.70	18.60	18.65
	50% NPK+50%Bio(2)	12.80	12.90	12.85	5.80	6.20	6.00	18.50	18.40	18.45
	50% NPK+50%Bio(3)	13.20	13.50	13.35	6.20	6.50	6.35	18.90	19.10	19.00
	50% NPK+50%Bio(4)	13.00	13.20	13.10	6.00	6.40	6.20	18.80	18.70	18.75
	Mean	12.98	13.18	13.08	5.98	6.35	6.16	18.73	18.70	18.72
chemical fertilizer	100% chemical fertilizer	11.90	12.10	12.00	5.20	5.60	5.40	18.80	18.20	18.30
L.S.D. at 5%	Fertilize source (A)	1.211	0.208		0.234	0.443		0.235	0.311	
	Treatments (B)	1.211	0.208		0.234	0.443		0.235	0.311	
Interaction	(AXB)	1.532	0.345		0.356	0.865		0.309	0.601	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

Leaf chemical composition:-

Concerning chlorophyll (a, b) and carotene contents of leaves as mentioned in Table (4) and leaf minerals(N, P, K, Fe, Zn and Mn) in Tables (5 & 6), it was clear that combination application (50%chem. +50% bio.) in general, resulted in a significant higher responses than those of single ones (chem. or bio.) in the two studied seasons. The significant lowest content of chlorophyll (a, b) and minerals were at the inoculated trees with biofertilizers only. On the other hand, leaf chlorophyll and mineral contents was significantly higher with the inoculation with 50% Rhizobacterein plus 50% chem. fertilizer which was more effective in enhancing chlorophyll formation and minerals content than the other biofertilizers or un inoculated trees. The results also indicated that the improving effect of fertilizer treatment sources on such growth parameters and on leaf chlorophyll and N, P, K, Fe, Zn and Mn mineral contents could be arranged in the following descending order (50%chem.+ 50% Rhizobacterien), (50%chem.+ 50% Microbien), (50%chem.+ 50% Nitrobein), (50%chem.+ 50% Biogien), 100% chem., Rhizobacterein, Microbien, Nitrobein and Biogien.

On the other hand, trees received chemical fertilizer as a single addition recorded the middle value. . These favorable influences may be explained on the basis of the physiological fact that N is known as an essential element for vegetative growth and plays a major role in nucleic acids and protein synthesis, cell division and elongation and protoplasm formation. The beneficial effects of the biofertilizer on vegetative growth and leaf chlorophyll formation and leaf minerals content may be related to the enhancing effects of N_2- fixing (Azotobacter and Azospirillum strains on morphology and physiology of root system and produced adequate amounts of GA_3, IAA and cytokinins as well as mineral contents which increased the surface area per unit root length and enhance root feeding branching with an eventual increase the uptake of nutrients from the soil.

Table (4): Leaf chlorophyll (a), (b) and carotene (mg/ 100gm fresh weight) contents of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Leaf pigment		Chlorophyll(a)			Chlorophyll (b)			Carotene		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	92.0	95.0	93.5	51.0	52.0	51.5	29.70	29.60	29.65
	Bio (2)	85.0	90.0	87.5	49.0	50.0	49.5	30.10	29.80	29.95
	Bio (3)	101.0	103.0	102.0	54.0	55.0	54.5	28.50	28.40	28.45
	Bio (4)	98.0	100.0	99.0	52.0	53.0	52.5	29.20	29.10	29.15
	Mean	94.0	97.0	95.5	51.5	52.5	52.0	29.38	29.23	29.31
Bio + chemical fertilizer	50% NPK+50%Bio(1)	111.0	116.0	113.5	60.0	61.0	60.5	26.50	26.40	26.45
	50% NPK+50%Bio(2)	108.0	110.0	109.0	58.0	60.0	59.0	27.10	26.90	27.00
	50% NPK+50%Bio(3)	121.0	129.0	125.0	65.0	67.0	66.0	25.20	25.00	25.10
	50% NPK+50%Bio(4)	115.0	122.0	118.5	63.0	64.0	63.5	26.10	25.80	25.95
	Mean	113.8	119.3	116.5	61.0	63.0	62.3	26.23	26.03	26.13
chemical fertilizer	100% chemical fertilizer	104.0	106.0	105.0	56.0	57.0	56.5	27.60	27.40	27.50
L.S.D. at 5%	Fertilize source (A)	0.001	0.014		0.013	0.012		0.001	0.002	
	Treatments (B)	0.003	0.019		0.026	0.023		0.002	0.003	
Interaction	(AXB)	0.004	0.103		0.141	0.133		0.003	0.005	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

These results are in harmony with those of (Larson *et al.*, 1962, Reese and Koo (1977), on Temple orange, Pomares, *et al.* (1983), on citrus trees, Ferguson *et al.*, 1987, Ibrahim and Abd El- Aziz (1993), on Balady mandarin and Huang, *et al.* (1995), on Satsuma mandarin, and Hegab and Ahmed (1997), on Navel orange trees Idso *et al.*, 1995). Bio-fertilizer with different strains of bacteria induced a significant increase in trees growth as well as number of leaves and branches. They all mentioned that biofertilizer with mineral Nitrogen fertilizer increased trees height, number of branches/tree, number of leaves, leaf chlorophyll, minerals content and nutritional status of the trees. The significant lowest contents of chlorophyll obtained from trees receiving biofertilizers only and the reverse concerning leaves carotene contents. These effects could be due to a set of soil microorganisms processing the ability and mobilizing the unavailable forms of nutrients elements to be available for absorption by roots. Application of bio fertilizers has been used in several fruit trees to improve growth due to its effect on carbohydrates accumulation.

Table (5): Leaf N, P, K (%) contents of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Leaf N, P, K		N			P			K		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	2.01	2.04	2.03	0.15	0.16	0.16	1.02	1.08	1.05
	Bio (2)	1.95	2.01	1.98	0.12	0.12	0.12	1.00	1.06	1.03
	Bio (3)	2.08	2.12	2.10	0.17	0.18	0.18	1.08	1.15	1.12
	Bio (4)	2.02	2.08	2.05	0.16	0.17	0.17	1.04	1.10	1.07
	Mean	2.02	2.06	2.04	0.15	0.16	0.16	1.04	1.10	1.07
Bio + chemical fertilizer	50% NPK+50%Bio(1)	2.20	2.25	2.23	0.21	0.23	0.22	1.16	1.24	1.20
	50% NPK+50%Bio(2)	2.15	2.20	2.18	0.19	0.21	0.20	1.14	1.21	1.18
	50% NPK+50%Bio(3)	2.40	2.45	2.43	0.28	0.31	0.30	1.22	1.32	1.27
	50% NPK+50%Bio(4)	2.30	2.34	2.32	0.25	0.27	0.26	1.19	1.29	1.24
	Mean	2.26	2.31	2.29	0.24	0.26	0.25	1.18	1.27	1.23
chemical fertilizer	100% chemical fertilizer	2.10	2.15	2.12	0.18	0.20	0.19	1.10	1.20	1.15
L.S.D. at 5%	Fertilize source (A)	0.011	0.021		0.001	0.003		0.004	0.006	
	Treatments (B)	0.012	0.022		0.002	0.002		0.005	0.005	
Interaction	(AXB)	0.133	0.124		0.004	0.005		0.007	0.007	

Table (6): Leaf Fe, Zn and Mn (p.p.m.)contents of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Leaf Fe, Zn and Mn (p.p.m		Fe			Zn			Mn		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	81.0	83.0	82.0	16.0	18.0	17.0	20.0	22.0	21.5
	Bio (2)	78.0	80.0	79.0	14.0	16.0	15.0	19.0	21.0	20.0
	Bio (3)	91.0	93.0	92.0	18.0	20.0	19.0	22.0	24.0	23.0
	Bio (4)	86.0	89.0	87.5	17.0	19.0	18.0	21.0	23.0	22.0
	Mean	84.0	86.3	85.1	16.3	18.3	17.3	20.5	22.5	21.5
Bio + chemical fertilizer	50% NPK+50%Bio(1)	99.0	101.0	100.0	22.0	24.0	23.0	25.0	27.0	26.0
	50% NPK+50%Bio(2)	96.0	98.0	97.0	21.0	23.0	22.0	24.0	26.0	25.0
	50% NPK+50%Bio(3)	110.0	114.0	112.0	26.0	29.0	27.0	29.0	31.0	30.0
	50% NPK+50%Bio(4)	105.0	109.0	107.0	24.0	27.0	25.5	26.0	28.0	27.0
	Mean	102.5	105.5	104.0	23.3	25.8	24.6	26.0	25.5	25.8
chemical fertilizer	100% chemical fertilizer	94.0	·96.0	95.0	20.0	22.0	21.0	27.0	28.0	27.5
L.S.D. at 5%	Fertilize source (A)	2.330	1.710		1.294	1.159		0.683	0.595	
	Treatments (B)	3.570	2.640		1.976	1.770		1.004	0.909	
Interaction	(AXB)	6.180	4.570		3.423	3.065		1.808	1.575	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

Fruiting:

1- Fruit set%:

It is clear from data presented in Table (7) that Valencia orange trees had the largest fruit set percent when fertilized by the combination treatments (50% chem.+50%bio) especially adding Rhizobacterein, while the bio single treatments recorded the lowest values especially using Biogein.

2- June drop%:

Table (7) reveals that fruit June drop increased by adding biofertilizers as single treatments, while the lowest value was by using combination treatments especially using Rhizobacterein.

Table (7): Fruit set, June drop and Fruiting(%) of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Fruiting parameters		Fruit set			June drop			Fruiting		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	18.20	18.30	18.20	83.40	83.10	83.30	1.11	1.13	1.12
	Bio (2)	17.10	17.30	17.20	86.00	85.40	85.70	1.05	1.07	1.06
	Bio (3)	19.10	19.30	19.20	80.60	80.20	80.40	1.20	1.23	1.22
	Bio (4)	18.70	18.90	18.80	81.40	81.00	81.20	1.15	1.19	1.17
	Mean	18.30	18.40	18.35	82.85	82.43	82.64	1.13	1.16	1.15
Bio + chemical fertilizer	50% NPK+50%Bio(1)	19.90	20.10	20.00	76.10	75.80	75.90	1.35	1.40	1.38
	50% NPK+50%Bio(2)	19.70	19.90	19.80	78.40	78.10	78.30	1.30	1.34	1.32
	50% NPK+50%Bio(3)	21.30	21.50	21.40	70.40	70.10	70.30	1.49	1.53	1.51
	50% NPK+50%Bio(4)	20.20	20.40	20.30	74.30	71.40	72.90	1.41	1.46	1.44
	Mean	20.28	20.48	20.38	74.80	73.90	74.40	1.39	1.43	1.41
Chemical fertilizer	100% chemical fertilizer	19.40	19.60	19.50	80.40	79.50	80.00	1.25	1.26	1.25
L.S.D. at 5%	Fertilize source (A)	0.006	0.004		0.001	0.001		0.017	0.021	
	Treatments (B)	0.005	0.004		0.002	0.002		0.014	0.022	
Interaction	(AXB)	0.007	0.005		0.004	0.003		0.126	0.124	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

3- Fruiting percent:

The same Table (7) indicate that trees treated with combination treatments had the largest fruiting percentage especially adding Rhizobacterein followed by chemical fertilizer as single whereas the lowest values were obtained from trees had biofertilizer only.

Regarding the effect of (chem.+ bio) in combinations on Valencia orange trees it was obvious that fruit set % and fruiting % had a significant increase, meanwhile, June drop% significantly decreased as a result of using (chem. + bio) in combinations. This may be due to the enhancement of trees nutrition status beside improving the growth of the trees. These results were in harmony with those obtained by Reese and Koo (1977), on Temple orange, Pomares, *et al.* (1983), on citrus trees, Huang, *et al.* (1995), on Satsuma mandarin and Hegab and Ahmed (1997), on Navel orange trees. They concluded that combination application between chemical and bio fertilizers improved trees growth which led to an increase in fruit set and fruiting percentage and decrease of June drop percent. The main observation showed that the increment may be due to the enhancing effect on the anabolic processes occurred in trees and involved energy transfer processes for initial flowering which led to improve fruiting percentage, due to its effect on carbohydrates accumulation

Yield:

Regarding the effect of biofertilizers and chemical fertilizers on yield, results concerning Table (8) indicated that high significant increments in yield (fruits number per tree, yield/tree as kg and yield /feddan as Tons) using inoculation with the tested biofertilizers in combination with chemical fertilizers treatments in both seasons. Moreover, Rhizobacterein had significantly the highest values of yield followed by Microbein, Nitrobein and Biogein Reese and Koo (1977), on Temple orange, Pomares, *et al.* (1983), on citrus trees, Huang, *et al.* (1995), on Satsuma mandarin and Hegab and Ahmed (1997) on Navel orange trees. Therefore, the combination treatments appears to be sufficient and adequate to produce maximum yield. The same authors found that inoculating with bacteria increased yield up to 27%. Combined application was favorable in increasing the yield than using single. The maximum yield was recorded for trees received Rhizobaterein plus chem. fertilizers. The stimulative effects of biofertilizers on enhancing yield were reported by many investigators, Motskobili, (1984) on Satsuma trees, Rabeh, *et al.* (1993), on Balady mandarin, El-Kobbiaobbia, (1999), on Navel orange trees and Grassi, *et al.* (1999) on Rangpour lime, indicated that using biofertilizers increased yield of the trees. Reese and Koo (1977), on Temple orange trees reported that the highest fruit yield was obtained from trees inoculated with biofertilizer and fertilized by 50% of recommended N rate. Abou Sayed, (1997), on Balady mandarin showed that the highest values of number of fruits per tree, fruit weight and total yield per tree were recorded from trees inoculated with multi biofertilizers.

Fruit physical and chemical properties:-

The results presented in Tables (9 and 10) indicate that the addition of biofertilizers plus chemical fertilizers gave significant increase in fruit weight(gm), fruit size(cm^3), juice percentage (%), total soluble solids (%), T.S.S./ acid ratio and Ascorbic acid(mg/ 100ml juice) as compared with the treatment of 100% NPK or biofertilizer as single application. Furthermore, the treatment of 50%NPK plus 50% Rhizobacterein gave higher values of fruit properties than the other sources of biofertilizers. All combined application significantly caused reduced acidity of fruit juice especially Rhizobacterein which showed the lowest percentage of acidity compared to the control (100%) chemical or bio fertilizers as single addition. These results could be due to beneficial effect on the leaf area of the trees which reflected in more carbohydrates production through photosynthesis process. In addition to the role of the biofertilizer in increasing the uptake of nutrients which advanced fruit ripening in terms of a decrease in juice acidity and an increase in juice T.S.S. and T.S.S / acid ratio and Ascorbic acid. These results are in accordance with the results of Larson *et al.*, (1962), Ferguson *et al.*, (1987), Idso *et al.*, (1995) and Hegab *et al.* (1997), they mentioned the possibility of using biofertilizers for improving nutritional status of the trees, the formation of flower initiation due to its effect on carbohydrates accumulation which lead to increasing the yield and improving fruit quality.

Table (8): Yield of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Yield		No. of fruits / tree			Yield / tree (Kg)			Yield / Feddan(Ton)		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	302.0	307.0	304.5	59.10	59.62	59.36	09.93	10.02	09.98
	Bio (2)	300.0	305.0	302.5	57.06	57.98	57.52	09.58	09.74	09.66
	Bio (3)	311.0	315.0	313.0	63.79	64.51	64.15	10.72	10.84	10.78
	Bio (4)	309.0	311.0	310.0	62.17	62.45	62.31	10.44	10.49	10.46
	Mean	305.5	309.5	307.5	60.53	61.14	60.84	10.17	10.27	10.22
Bio + chemical fertilizer	50% NPK+50%Bio(1)	340.0	344.0	342.0	76.60	78.12	77.36	12.87	13.12	12.99
	50% NPK+50%Bio(2)	322.0	326.0	324.0	74.09	72.40	73.25	12.45	13.66	13.06
	50% NPK+50%Bio(3)	370.0	376.0	373.0	88.95	91.93	90.44	14.94	15.44	15.19
	50% NPK+50%Bio(4)	350.0	356.0	353.0	80.64	83.16	81.90	13.55	13.97	13.76
	Mean	343.0	350.5	346.8	80.07	81.40	80.74	13.45	14.05	13.75
chemical fertilizer	100% chemical fertilizer	318.0	322.0	320.0	66.68	65.30	65.99	11.20	10.97	11.09
L.S.D. at 5%	Fertilize source (A)	6.104	8.144		0.455	0.301		0.005	0.004	
	Treatments (B)	6.366	7.326		0.545	0.472		0.006	0.003	
Interaction	(AXB)	7.901	8.630		0.640	0.544		0.008	0.007	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

Soil pH and NPK contents:

Table (11) show the effect of treatments on soil pH and NPK contents which were determined before adding the fertilizers and at the end of the last season. The obtained results emphasized that pH value under 50% chemical fertilizerplus 50% bio fertilizer was significantly decreased comparing with the recommended 100% chemical fertilizer or biofertilizer solely. The superior treatment in reducing soil pH value was inoculation with mixture of bio (3) i.e. with Rhizobacterein . The obtained results are in harmony with those reported by Reese and Koo (1977) on Temple orange, Pomares, *et al.* (1983), on citrus trees, Ibrahim and Abd El- Aziz (1993), on Balady mandarin, and El-Kobbiaobbia, (1999), on Navel orange trees. They conducted that addition biofertilizer play an important role in soil pH values and the reduction effect depending on bio fertilizers source. Concerning N, P and K soil contents as affected by different fertilizer types, Moreover the same data of Table

(11) indicate that, in general all treatments significantly increased the available nitrogen, phosphorus and potassium soil contents except 100% chemical fertilizers (control) beside, some of these increments were highly significant, due to 50% chemical and 50% Rhizobacterein than others of bio fertilizers. The lowest value was obtained by adding chemical fertilizers only. The changes reflected of the chemical and bio transformation that took place in growth media and the availability of some nutrients may be due to microbial decomposition of organic matter causing production of organic acids and CO_2 which combined with water to form carbonic acid, which in turn reduced soil pH value and increased the availability of some nutrients.

Table (9): Some fruit physical properties of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Some fruit physical properties		Fruit weight(gm)			Fruit size(cm^3)			Juice percentage (%)		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	195.40	194.20	194.80	182.00	180.00	181.00	41.0	38.0	39.5
	Bio (2)	190.20	190.10	190.15	180.00	176.00	178.00	39.0	36.0	37.5
	Bio (3)	205.10	204.80	204.95	191.00	190.00	190.50	47.0	44.0	45.5
	Bio (4)	201.20	200.80	201.00	186.00	186.00	186.00	43.0	40.0	41.5
	Mean	197.98	197.48	197.73	184.80	183.00	183.90	42.5	39.5	41.0
Bio + chemical fertilizer	50% NPK+50%Bio(1)	225.30	227.10	226.20	209.00	213.00	211.00	54.0	55.0	54.5
	50% NPK+50%Bio(2)	220.10	222.10	221.10	204.10	208.00	206.00	52.0	54.0	53.0
	50% NPK+50%Bio(3)	240.40	244.50	242.50	224.60	232.00	228.30	66.0	71.0	68.5
	50% NPK+50%Bio(4)	230.40	233.60	232.00	214.20	220.00	217.10	60.0	65.0	62.5
	Mean	229.05	231.83	230.44	212.98	218.25	215.62	58.0	61.3	59.6
chemical fertilizer	100% chemical fertilizer	202.70	209.80	206.25	193.00	192.00	192.50	50.0	47.0	48.5
L.S.D. at 5%	Fertilize source (A)	6.444	5.113		6.104	8.144		0.455	0.301	
	Treatments (B)	7.109	6.378		6.366	7.326		0.545	0.472	
Interaction	(AXB)	7.786	7.635		7.901	8.630		0.640	0.544	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

Soil microorganism:-

1- CO_2 evaluation:-

Data of Table (12) concerning the effect of bacterial inoculation from the addition of biofertilizers or chemical fertilizer as single or in combination on CO_2 evaluation, the results obtained show clearly that soil CO_2 evaluation content in descending order 100% Nitrobein, 100% Microbein, 100% Biogein, 100% Rhizobacterein, 50% NPK + 50% Nitrobein, 50% NPK + 50% Microbein, 50% NPK + 50% Biogein, 50% NPK +50% Rhizobacterein, 100% chemical fertilizer, untreated soil. Generally, soil treated with single application of biofertilizers recorded the highest values than others.

Table (10): Some fruit Chemical properties of Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio).

Some fruit Chemical properties		T.S.S.(%)			Acidity(%)			T.S.S. / acid ratio			Ascorbic acid (mg/100ml juice)		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	11.10	11.30	11.20	1.18	1.26	1.22	9.40	8.97	9.19	32.0	34.0	33.0
	Bio (2)	10.80	11.10	10.95	1.21	1.29	1.25	8.92	8.60	8.76	31.0	33.0	32.0
	Bio (3)	11.40	11.70	11.55	1.12	1.20	1.16	10.18	9.75	9.97	34.0	36.0	35.0
	Bio (4)	11.30	11.60	11.45	1.16	1.24	1.20	9.74	9.35	9.55	33.0	35.0	34.0
	Mean	11.15	11.43	11.29	1.17	1.25	1.21	9.56	9.17	9.37	32.5	34.5	33.5
Bio + chemical fertilizer	50% NPK+50% Bio(1)	11.90	12.20	12.05	1.07	1.08	1.08	11.12	11.29	11.21	44.0	46.0	45.0
	50% NPK+50% Bio(2)	11.70	12.00	11.85	1.09	1.10	1.09	10.73	10.91	10.82	40.0	42.0	41.0
	50% NPK+50% Bio(3)	12.40	12.70	12.55	1.02	1.04	1.03	12.16	12.21	12.19	51.0	53.0	52.0
	50% NPK+50% Bio(4)	12.20	12.50	12.35	1.06	1.08	1.07	11.51	11.57	11.54	48.0	50.0	49.0
	Mean	12.05	12.35	12.20	1.06	1.08	1.07	11.38	11.49	11.44	45.8	47.8	46.8
chemical fertilizer	100% chemical fertilizer	11.50	11.70	11.60	1.10	1.20	1.15	10.45	9.75	10.20	37.0	40.0	38.5
L.S.D. at 5%	Fertilize source (A)	1.013	0.001		1.011	1.013		1.451	1.450		0.179	0.108	
	Treatments (B)	0.234	0.002		0.234	0.234		1.654	1.643		1.001	0.198	
Interaction	(AXB)	1.062	0.004		1.065	1.062		0.322	0.321		1.664	1.780	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

2- Dehydrogenase activity:

Table (12) cleared that the treatment of single application with biofertilizers gave the highest dehydrogenase activity followed with the combination treatment. On the other hand, soil dehydrogenase activity of 100% chemical fertilizer took the other way around then the untreated soil.

3- Total count of bacteria:-

The same data of Table (12) showed that the highest total count of bacteria was obtained from single biofertilizer treatments especially adding Nitrobein ($226x16^5$) while, the lowest values obtained with untreated soil. Thus, single treatments with biofertilizers recorded the highest total of bacteria than the combination treatments or chemical treatment, while untreated treatment recorded the lowest values.

Table (11): Soil pH and NPK contents (p.p.m.) as affected by two types of fertilizer sources (mineral and bio) and planted with Valencia orange trees.

Soil pH and NPK contents		pH			N			P			K		
Fertilizer source	Treatments	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
Before treatment		8.52			74.7			11.8			50.0		
Bio fertilizer	Bio (1)	8.36	8.31	8.36	84.6	88.7	86.7	18.4	19.4	18.9	47.0	76.0	61.5
	Bio (2)	8.31	8.28	8.26	93.9	99.1	96.5	26.1	29.1	27.6	35.0	74.0	54.5
	Bio (3)	8.21	8.18	8.20	99.4	96.7	99.6	31.2	39.5	35.4	62.0	135.0	98.5
	Bio (4)	8.24	8.21	8.23	96.3	95.8	96.1	28.9	30.4	29.7	55.0	132.0	93.5
	Mean	8.28	8.25	8.26	93.6	95.8	94.7	26.2	29.6	27.9	49.8	104.3	77.0
Bio + chemical fertilizer	50% NPK+50%Bio(1)	8.23	8.21	8.22	99.3	117.0	108.2	21.2	31.3	26.3	54.0	86.0	70.0
	50% NPK+50%Bio(2)	8.16	8.14	8.15	93.3	96.4	94.9	20.7	24.7	22.7	51.0	81.0	66.0
	50% NPK+50%Bio(3)	8.12	8.14	8.13	141.0	146.0	143.5	24.4	57.1	40.8	66.0	149.0	107.5
	50% NPK+50%Bio(4)	8.21	8.23	8.22	125.0	138.0	131.5	22.1	50.1	36.1	61.0	144.0	102.5
	Mean	8.18	8.18	8.18	114.7	124.4	119.5	22.1	40.8	31.5	58.0	115.0	86.5
chemical fertilizer	100% chemical fertilizer	8.41	8.38	8.39	78.3	83.5	80.9	20.7	24.7	22.7	54.0	86.0	70.0
L.S.D. at 5%	Fertilize source (A)	0.001	0.001		1.451	1.450		0.001	0.002		1.013	1.012	
	Treatments (B)	0.002	0.002		1.654	1.643		0.002	0.004		0.234	0.234	
Interaction	(AXB)	0.123	0.121		0.322	0.321		0.004	0.006		1.062	1.060	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

Table (12): Effect of chemical and Bio fertilizer on CO_2 evaluation, dehydrogenase activity, total count of bacteria and organic carbon of 100 gm dried soil which was planted with Valencia orange trees at the end of the experiment.

Soil microorganisms contents		CO_2 evaluation (mg CO_2/ 100g soil)	Dehydrogenase activity (mg DHA ,100g soil)	Total count of bacteria X10^3	Organic carbon
Fertilizer source	**Treatments**				
Bio fertilizer	Bio (1)	304.7	203.9	226.0	15.2
	Bio (2)	256.3	172.8	155.0	10.6
	Bio (3)	184.8	87.3	136.0	10.1
	Bio (4)	279.4	172.1	163.0	11.5
Mean		231.3	159.0	170.0	11.9
Bio + chemical fertilizer	50% NPK+50%Bio(1)	158.3	76.6	90.0	8.3
	50% NPK+50%Bio(2)	109.9	67.0	80.0	5.9
	50% NPK+50%Bio(3)	71.5	34.1	70.0	4.8
	50% NPK+50%Bio(4)	133.0	76.1	85.0	6.5
Mean		118.2	63.5	81.3	6.4
Chemical fertilizer	100% chemical fertilizer	55.3	16.9	25.1	2.8
	Untreated	25.3	06.6	5.3	0.6
L.S.D. at 5%	Fertilize source (A)	0.001	1.450	1.451	1.450
	Treatments (B)	0.002	1.643	1.654	1.643
Interaction	(AXB)	0.123	0.321	0.322	0.321

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen
Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen

4- Organic Carbon:-

Data of Table (12) show that single treatment with biofertilizers were the preferable than the combination once in soil organic carbon content. The highest soil organic carbon content value was obtained from the soil treated with Nitrobein as single treatment.

Generally, the addition of biofertilizer to the sandy soil improved its microorganism . These results agree with those obtained by Ishac *et al.*, 1982, El-Haddad *et al.*, 1986 and El-Ghany., 1996. They concluded that, the various positive effects and benefits of applying biofertilizers were attributed to its own different nutrients and the natural plant hormone namely, cytokinins. Inoculation with Azotobacter had an effect on total bacterial counts, Azotobacter spp. Inoculation of plants with Azospirillum increased total number of bacteria, CO_2 evaluation, dehydrogenase activity and organic carbon in soil . The influence of different biofertilizer types either as N_2-fixing or P-dissolving bacteria on soil microbiological properties in sandy soils were as follows: Nitrobein> Microbein >Biogein> Rhizobacterein .

Economic benefit study:-

Data presented in Table (13) show the economical value to the using of biofertilizers as single application or in the combination with chemical fertilizers and using of 100% chemical fertilizers. It is clearly show that higher values of"net return" were gained by the treatment 50% biofertilizer plus 50% chemical fertilizer compared with biofertilizer or chemical fertilizer each as single addition. In addition, the highest benefit values was obtained with the treatment of biofertilizer"Rhizbacterein in combination with chemical fertilizer(5286.5)L.E., while the net return of chemical fertilizer was about (2985.3)L.E. On the other hand, the results indicated also that, the inoculation of Valencia orange trees with any of the biofertilizer used in combination with chemical fertilizer was associated with higher values of net return than the un inoculated (chemical fertilizer) or with biofertilizer as single treatment.

The average net return were (5286.5, 4567, 4113.8, 3982.7, 2985.3, 2923.3, 2918, 2796.9 and 2646.7 in descending order for 50% Rhizobacterein + 50%chem., 50% Microbein + 50%chem., 50% Nitrobein + 50%chem., 50% biogein + 50% chem., 100% chem., 100% Micro and 100% Rhizo., 100% Biogein and the lowest net return was obtained from using 100% Nitro. These results are in agreement with those of Ghoneim and Abd El-Razik (1999); Abd El-Fattah (2000) Gaber *et al* .(2001) and El-Khatib *et al.* (2003).

CONCLUSION

Generally, from the above mentioned results, it can be concluded that combining bio with chemical fertilizers reduced the need for chemical fertilizers by approximately 50% and increase the net return, beside, improving the nutritional status of the trees and fruit quality and structure and microorganism of the sandy soil and saving the environment against pollution by chemical fertilizers application and protect the maintain the bio activity of soil concerning minerals and microorganism contents.

Table (13): Cost benefit of different treatments applied to Valencia orange trees as affected by two types of N fertilizer sources (mineral and bio). (168 trees /Feddan).

Cost benefit		Yield/ Feddan (Tons)			Economical value L.E. / Feddan							
					Cost of application per season	Cost of production per season	Total price of yield			Net return		
Fertilizer source	Treatments	2005	2006	Mean			2005	2006	Mean	2005	2006	Mean
Bio fertilizer	Bio (1)	9.93	10.02	9.98	574	3837	6454.5	6513.0	6483.8	2617.5	2676.0	2646.8
	Bio (2)	9.58	9.74	9.66	742	4005	6227.0	6331.0	6279.0	2222.0	3371.9	2796.9
	Bio (3)	10.72	10.84	10.78	826	4089	6968.0	7046.0	7007.0	2879.0	2957.0	2918.0
	Bio (4)	10.44	10.49	10.46	616	3879	6786.0	6818.5	6802.3	2907.0	2939.5	2923.3
	Mean	10.17	10.27	10.22	690	3953	6601.4	6677.1	6639.3	2648.0	2724.1	2686.3
Bio + chemical fertilizer	50% NPK+50%Bio(1)	12.87	13.12	12.99	536	3799	8365.5	8528.0	8446.8	4566.5	4729.0	4113.8
	50% NPK+50%Bio(2)	12.45	13.66	13.06	620	3883	8092.5	8879.0	8485.8	4209.5	4996.0	3982.7
	50% NPK+50%Bio(3)	14.94	15.44	15.19	662	3925	9711.0	10036.0	9873.5	5786.0	6111.0	5286.5
	50% NPK+50%Bio(4)	13.55	13.97	13.76	557	3820	8807.5	9080.5	8944.0	4987.5	5260.5	4567.0
	Mean	13.45	14.05	13.75	594	3857	8744.1	9130.9	8937.1	4987.5	5273.0	4577.7
chemical fertilizer	100% chemical fertilizer	11.20	10.97	11.09	498	3761	7280.0	7130.5	7208.5	3519.0	3369.5	2985.3
L.S.D. at 5%	Fertilize source (A)	1.231	1.444		1.111	1.080	1.451	1.450		1.871	1.770	
	Treatments (B)	1.394	1.237		1.224	1.073	1.654	1.643		1.345	1.985	
Interaction	(AXB)	0.222	0.216		0.452	0.471	0.322	0.321		0.376	0.435	

Bio (1): 1/2k g Nitrobein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen Total price of chemical fertilizer per (Ton) Total price of biofertilizers per (Kg) Bio (2): 1/2k g Biogein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen Ammonium sulphate (1000 L.E.) Rhizobacterein 1Kg= 5L.E.

Bio (3): 1/2k g Rhizobacterin+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen Super phosphate (900 L.E.) Microbein 1Kg= 2.5L.E.

Bio (4): 1/2k g Microbein+ 200g phosphorein+ 1/4 L. potassein / 20 L. water +80gm Coatangen Potassium sulphate (2900 L.E.) Nitobein 1Kg=2L.E.

Total price of Valencia orange fruitsper Ton (650 L.E.) EDTAH(per Kg) Biogein 1Kg=4L.E

Production cost except of application cost equal 3263L.E. per feddan Fe(65 L.E.), Zn(55L.E.), Mn(45L.E.) Phosphorein 1Kg=4L.E

Potassein 1L=5L.E

Cotaengein 1Kg = 5L.E.

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إستجابة أشجار البرتقال الفالنسيا الى مصادر مختلفة من الأسمدة الحيوية

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أجريت هذه الدراسة فى موسمين ٢٠٠٥/ ٢٠٠٦ فى مزرعة خاصة بالبحيرة على أشجار البرتقال الفالنسيا عمرها عشر سنوات ومطعومة على أصل النارنج ونامية فى تربة رملية حيث استخدام مصادر مختلفة من الأسمدة الحيوية وهى النتروبين، البيوجين، الريزوباكترين والميكروبين كمثبتات للنتروجين بمعدل ١/٢ و١/٤كيلوجرام للشجرة /السنة مقسمة على ثلاث دفعات أضيفت فى يناير ومارس وأغسطس كما تم استخدام الفوسفورين بمعدل ٢٠٠و١٠٠ جرام للشجرة فى السنة كدفعة واحدة فى يناير وكذلك استخدم البوتاسين كمصدر للبوتاسيوم بواقع ١/٤ و١/٨/لتر لكل ٢٠ لتر ماء ترش مرتين قبل التزهير وبعد العقد كما تم رش الأشجار بمحلول محتوى على الكونتجين كمصدر لعناصر الحديد-الزنك-المنجنيز بمعدل ٨٠ و٤٠جرام للشجرة رشت على الأشجار ثلاث مرات فى فبراير وبعد العقد وبعد شهر من المرة الثانية وذلك فى المعاملات ١٠٠%و٥٠% على الترتيب. أما السماد الكيماوى فاستخدم بمعدل ٨٠٠، ٤٠٠، ٤٠٠ جرام للشجرة لعناصر النتروجين، الفوسفور، البوتاسيوم فى المعاملة ١٠٠% سماد كيماوى ونصف الكمية فى معاملة ٥٠% كما تم رش الأشجار بمحاليل من عناصر الحديد، الزنك، المنجنيز بتركيز٤.و% وكل هذه الإضافات كانت فى نفس مواعيد إضافات الأسمدة الحيوية وذلك بهدف أمكانية تحسين النمو الخضرى والعقد والمحصول وجودة الثمار. ومحتوى التربة من العناصر والبكتريا كما تم عمل دراسةعلى أثر استخدام هذه المخصبات على العائد الإقتصادى وكانت أهم النتائج المتحصل عليها كالآتى:

١- كل المعاملات سببت زيادة فى النموالخضرى والمحصول وجودة الثمار.

٢- استخدام الأسمدة الحيوية مع الكيماوية بمعدل النصف لكل منهما من الكمية المحددة أعطى أفضل النتائج فى تحسين النمو الخضرى (طول الفرع- عدد الأوراق/فرع- مساحة الورقة). كذلك فى محتوى الأوراق من كلوروفيل أ ، ب والعناصر الكبرى والصغرى (N, P, K Fe, Zn, Mn) والعقد والمحصول وكذلك فى وزن الثمار وحجمها ونسبة العصير ونسبة المواد الصلبة الذائبة ونسبة المواد الصلبة الذائبة إلى الحموضة وكذلك فيتامين ج كما أدت الى زيادة فى محتوى

التربة من عناصر (N.P.K) والمحتوى الميكروبى كذلك ارتفع العائد الإقتصادى من الفدان فى السنة.

على العكس من ذلك فقد أحدثت المعاملات نقص فى محتوى الورقة من الكاروتين وكذلك نسبة تساقط الثمار وحموضة الثمار الكلية كما أدت الى نقص (pH) التربة.

٣- المعاملات المنفردة من الأسمدة الحيوية كان لها تأثير كبير على محتوى التربة الميكروبى حيث سجلت أعلى النتائج عن المعاملات المخلوطة أوالكيماوية.

٤- يفضل استخدام ٥٠% من السماد الحيوى خاصة سماد الريزوباكترين مع ٥٠% من كمية السماد الكيماوى. مما أعطى أفضل النتائج من حيث تحسين النمو الخضرى والمحصول وصفات الجودة للثمار ومحتوى التربة من عناصر (N.P.K) والمحتوى الميكروبى كما ارتفع العائد الإقتصادى من الفدان فى السنة مما يدعو للتوصية بتطبيقها.